

Climate and hydrological variability: the catchment filtering role

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Response to Referee Comment RC-C4466-2014 – Anonymous Referee #3

On behalf of the co-authors, I wish to thank Anonymous Referee #3 for his/her constructive and useful comments, and in particular for the very interesting questions raised, concerning the limitations of the modelling approach and future research topics to the study's results.

Here are our responses to the specific issues mentioned by Referee#3.

1. About the transferability of the results

The results presented in the paper derive from a set of highly simplified assumptions, especially concerning the rainfall-runoff process (please see the premise of our reply to referee #2). Such assumptions and in particular, the values adopted for the parameters involved, limit the range of hydrological catchments for which the modelling approach in our study is representative. Results cannot be directly transferred to other catchments and/or hydrological regimens different from those mentioned in the manuscript. However, the proposed framework is flexible and general for the analysis of catchments where the rainfall-runoff model is reliable and the stochastic rainfall model fits the local climatic conditions.

In this respect, and according to this Referee's comment, the text of the paper has been improved by adding a description of the type of Mediterranean catchments under consideration, including additional research references centred on case-studies, these being good examples to illustrate the geomorphology, climate and type of hydrological context under investigation (Olivares Guillem,2000; Camarasa Belmonte, 1990).

1 The reference cited by Referee #3 (Troch et al, 2013) will be included as well in the new
2 version of the manuscript, to better clarify the scope of our research. In particular, Troch et al.
3 (2013) put much emphasis on the interaction between landscape characteristics and the river
4 flow regime.

5 In the revised version of the manuscript we will make clear that in our study we investigate
6 the interaction among rainfall forcing and rainfall-runoff transformation, where the latter is
7 modelled through a lumped rainfall-runoff model that cannot directly take into account the
8 landscape behaviours. In our framework these are accounted for implicitly, through the use of
9 a proper model structure and parameters.

10 The use of a lumped model is justified by our will to analytically assess the above
11 interactions. The use of a more detailed rainfall-runoff model may allow one to better assess
12 the impact on the results of local catchment properties. However, a numerical simulation
13 should be used in this case to produce the results, as the analytical approach would not be
14 applicable anymore. The use of more detailed models is a future perspective that we aim to
15 investigate, but in our opinion it goes beyond the scope of the present study.

16 17 **2. About seasonality in the rainfall model**

18 We agree with the Referee's comment that rainfall properties of course change with the
19 season. For the region that is considered in our study, convective storms usually occur during
20 Autumn, particularly in September and October, while frontal events mostly occur during
21 Winter and Spring. Maximum rainfalls (rainfall peaks) occur systematically during Autumn.

22 The rainfall model that we use can potentially reproduce both frontal and convective events
23 (see for instance a discussion of considering seasonality within this rainfall model in Andrés-
24 Doménech et al., 2010). In this study, though, seasonality is not specifically accounted for.
25 We assume that climatic variability may occur through an intensification of rainfall events,
26 and we investigate in what conditions it may imply or not an amplification of floods, that is,
27 to what extent rainfall-runoff transformation may filter out or amplify the effects of climate
28 change.

3. On the accuracy of the model for other places

As previously mentioned, the results reported in the paper cannot be transferred to other catchments and/or hydrological regimens different from those specified therein, unless the analysis is repeated for different sets of rainfall and rainfall-runoff model parameters. We have revised the text of the manuscript regarding this point, and have clarified the context of the analysis, by offering additional details on the type of Mediterranean catchments under consideration. As mentioned before, references have been added concerning this point.

4. About the sensitivity analysis

This is a very interesting point, to be addressed in the revised version of the manuscript. In particular, and following the Referee's suggestion, the conclusions of the paper will emphasize the contribution of the research as a first step towards a more detailed analysis which may be carried out by relaxing some of the initial assumptions. More specifically, the potential extension of the sensitivity analysis considering different combinations of catchment response parameters will be mentioned as a way forward for future research.

5. On the interactions between parameters/inputs

Several relevant interactions between parameters and inputs are considered in the paper, although analysed in a simplified way. We believe that these illustrate the main results presented in the conclusions, being clear the scope and limitations of the study. In this regard, we actually agree with Referee #3 that the analytical sensitivity analysis could be performed in a more comprehensive way. The work we have done, as such, highlights the main factors which influence the filtering role of the catchment, and thus, the preliminary conclusions are an interesting first step and base for future, more detailed analyses. Following the methodology described in this research, other interactions (for example those existing involving the concentration time and the storage capacity), or even other more complex rainfall-runoff transformations, might well be considered in future studies. The assumptions conditioning our study will be better explained in the revised version of the manuscript.

6. Showing in a higher dimensional space how input and storage parameters interact

As mentioned by Referee #3, in an earlier version of the paper we considered presenting the results (Figures 1 and 2 in the original manuscript) graphically on a 2D surface. In fact, we finally decided to summarize these bi-variate analyses into simpler 1D graphs, including the second component of the analysis (β/β_0 in the case of Figure 1 and S/μ_V in Figure 2 in the original manuscript) in terms of several 1D curves, as submitted in version-1 of the paper. We believe that such 1D representations are clearer and more illustrative for the reader than the 2D graph. As an example, we present herein the 2D representation resulting from [Figure 2, scenario 1.a.]. In our opinion, the graph does not make interpreting the results easy and that is why we decided against including it in the paper. However, we can include one of them if the Editor prefers so.

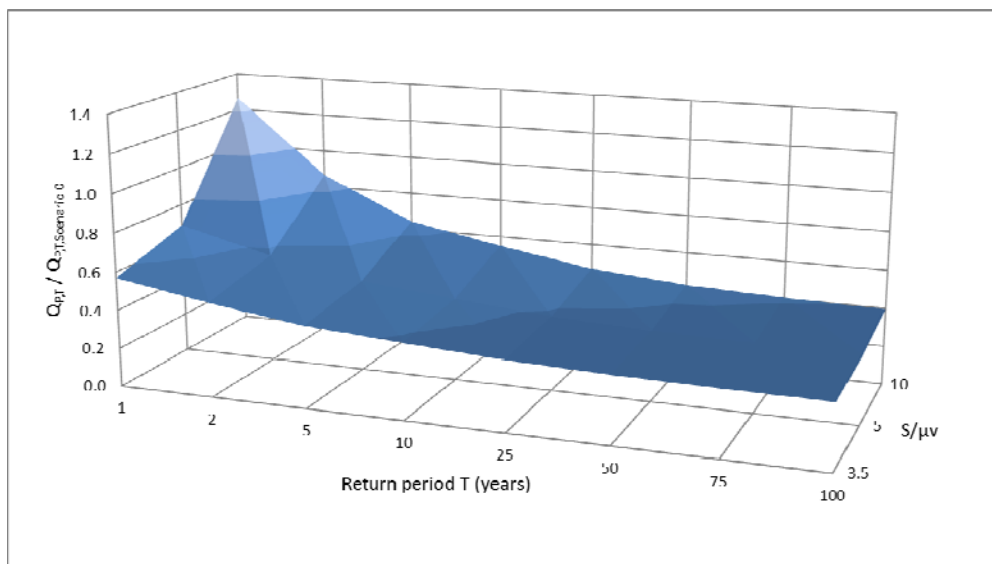


Figure. Flood quantile variations for scenarios 1.a (+30% μ_V) for $S/\mu_V = 3.5, 5$ and 10 .

Additional References

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